

**City of Brentwood**  
**Application Number: 6123**

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**ENGINEERING EVALUATION**  
**CITY OF BRENTWOOD; SITE 14830**  
**APPLICATION 6123**

**BACKGROUND**

The City of Brentwood has applied for an Authority to Construct a new cogeneration unit powered by a rich-burn natural gas engine (S-1). The engine will be installed in mid-December, 2002 at 195 Griffith Lane, Brentwood, CA. The engine will be installed within 1000 feet of Brentwood Elementary School, thus Waters Bill School Public Notice is triggered. The engine will be used for heating a swimming pool as well as providing power to pumps to re-circulate the water within the pool.

The source within this application is:

**S-1 Gas Fired Prepackaged Cogeneration Unit, 60 kW: Rich Burn Natural Gas Spark Ignition Engine, Make: Tecogen, Model: CM-60, Rated Horsepower: 85 HP. Abated by Non-Selective Catalyst Reduction (NSCR) Catalytic Converter: Make: Johnson Matthey.**

S-1 is a new source as defined in Regulation 2, Rule 1, Section 232.

**EMISSIONS**

Basis:

Daily and annual emissions from S-1, assuming a requested 7000 hrs/yr of total annual operation, a maximum of 24 hrs/day, and 85 bHP at full load, will be calculated using the Johnson Matthey emission control specification abatement efficiency of 98.9% by weight for NO<sub>x</sub>, 96.4% by weight for CO, 94.0% by weight for POC, and 93.5% by weight for NPOC and emissions factors as listed in AP-42, Volume 1, Fifth Edition, Chapter 3: Stationary Internal Combustion Sources, Section 3.2: Natural Gas-fired Reciprocating Engines, Table 3.2-3: Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines and California Air Toxic Emission Factors, where noted. The higher emission factor of the two sources was used in determining emissions:

Engine Displacement: 454 cubic inches  
Fuel Consumption: 797,000 Btu/hr @ Full Load

|                    |           |          |
|--------------------|-----------|----------|
| NO <sub>x</sub> :  | 2.21      | lb/MMBtu |
| CO:                | 3.72      | lb/MMBtu |
| SO <sub>2</sub> :  | 5.88 E-04 | lb/MMBtu |
| PM <sub>10</sub> : | 9.5 E-03  | lb/MMBtu |
| VOC:               | 2.96 E-02 | lb/MMBtu |

**Formulas for Calculating Emissions:**

|  |               |
|--|---------------|
| (24 hrs/day) (0.797 MMBtu) (X.XX lb/MMBtu) (1 - % Reduction Efficiency)  | = X.XX lb/day |
| (7000 hrs/yr) (0.797 MMBtu) (X.XX lb/MMBtu) (1 - % Reduction Efficiency) | = X.XX lb/yr  |
| (X.XX lb/yr) (1 ton/ 2000 lbs)   | = X.XX ton/yr |

**City of Brentwood**  
**Application Number: 6123**

**TABLE 1: Criteria Pollutants**

| Pollutant:             | Unabated Emissions            |                                 |                                  | Abated Emissions              |                                 |                                  |
|------------------------|-------------------------------|---------------------------------|----------------------------------|-------------------------------|---------------------------------|----------------------------------|
|                        | Maximum Daily usage (lbs/day) | Maximum Annual Usage (lbs/year) | Maximum Annual Usage (tons/year) | Maximum Daily usage (lbs/day) | Maximum Annual Usage (lbs/year) | Maximum Annual Usage (tons/year) |
| <b>NO<sub>x</sub></b>  | 42.27                         | 12329.59                        | 6.1648                           | 0.47                          | 135.63                          | 0.0678                           |
| <b>CO</b>              | 71.16                         | 20753.88                        | 10.3769                          | 2.56                          | 747.14                          | 0.3736                           |
| <b>SO<sub>x</sub></b>  | 0.01                          | 3.28                            | 0.0016                           | 0.01                          | 3.28                            | 0.0016                           |
| <b>PM<sub>10</sub></b> | 0.18                          | 53.00                           | 0.0265                           | 0.18                          | 53.00                           | 0.0265                           |
| <b>VOC</b>             | 0.57                          | 165.14                          | 0.0826                           | 0.03                          | 9.91                            | 0.0050                           |

**TOXIC RISK SCREEN ANALYSIS**

**TABLE 2: Toxic Air Contaminants (TACs)**

| Compound                    | Emission Factor (1) | Emission        | Toxic Trigger (2) | Above Trigger ? |
|-----------------------------|---------------------|-----------------|-------------------|-----------------|
|                             | (lbs/MMBtu)         | (lbs/yr)        | (lbs/yr)          | (Yes/No)        |
| 1,1,2,2 - Tetrachloroethane | 2.53E-05            | 8.47E-03        | 3.30E+00          | NO              |
| 1,1,2-Trichloroethane       | 1.53E-05            | 5.12E-03        | 1.20E+01          | NO              |
| 1,1-Dichloroethane          | 1.13E-05            | 3.78E-03        | 1.20E+02          | NO              |
| 1,2-Dichloroethane          | 1.13E-05            | 3.78E-03        |                   |                 |
| 1,2-Dichloropropane         | 1.30E-05            | 4.35E-03        |                   |                 |
| 1,3-Butadiene               | 6.63E-04            | 2.22E-01        | 1.10E+00          | NO              |
| 1,3-Dichloropropene         | 1.27E-05            | 4.25E-03        |                   |                 |
| <i>Acenaphthene</i>         | <i>3.32E-06</i>     | <i>1.11E-03</i> |                   |                 |
| <i>Acenaphthylene</i>       | <i>1.59E-05</i>     | <i>5.32E-03</i> |                   |                 |
| Acetaldehyde                | 2.79E-03            | 9.34E-01        | 7.20E+01          | NO              |
| Acrolein                    | 2.63E-03            | 8.80E-01        | 3.90E+00          | NO              |
| <i>Anthracene</i>           | <i>2.58E-06</i>     | <i>8.64E-04</i> | <i>1.90E+04</i>   | NO              |
| Benzene                     | 1.58E-03            | 5.29E-01        | 6.70E+00          | NO              |
| <i>Benzo(a)anthracene</i>   | <i>3.30E-07</i>     | <i>1.10E-04</i> |                   |                 |
| <i>Benzo(a)pyrene</i>       | <i>1.48E-07</i>     | <i>4.95E-05</i> | <i>8.70E+00</i>   | NO              |
| <i>Benzo(b)fluoranthene</i> | <i>2.95E-07</i>     | <i>9.87E-05</i> |                   |                 |
| <i>Benzo(g,h,i)perylene</i> | <i>2.40E-07</i>     | <i>8.03E-05</i> |                   |                 |
| <i>Benzo(k)fluoranthene</i> | <i>1.15E-07</i>     | <i>3.85E-05</i> | <i>4.40E-02</i>   | NO              |
| Butyr/Isobutyraldehyde      | 4.86E-05            | 1.63E-02        |                   |                 |
| Carbon Tetrachloride        | 1.77E-05            | 5.92E-03        | 4.60E+00          | NO              |
| Chlorobenzene               | 1.29E-05            | 4.32E-03        | 1.40E+04          | NO              |

**City of Brentwood**  
**Application Number: 6123**

| <b>Table 2</b>                |                            |                 |                          |                        |
|-------------------------------|----------------------------|-----------------|--------------------------|------------------------|
| <b>Compound</b>               | <b>Emission Factor (1)</b> | <b>Emission</b> | <b>Toxic Trigger (2)</b> | <b>Above Trigger ?</b> |
|                               | <b>(lbs/MMBtu)</b>         | <b>(lbs/yr)</b> | <b>(lbs/yr)</b>          | <b>(Yes/No)</b>        |
| Chloroform                    | 1.37E-05                   | 4.59E-03        | 3.60E+01                 | NO                     |
| <i>Chrysene</i>               | 3.87E-07                   | 1.30E-04        |                          |                        |
| <i>Dibenz(a,h)anthracene</i>  | 1.42E-08                   | 4.75E-06        | 4.40E-02                 | NO                     |
| Ethane                        | 7.04E-02                   | 2.36E+01        |                          |                        |
| Ethylbenzene                  | 2.48E-05                   | 8.30E-03        |                          |                        |
| <i>Fluoranthene</i>           | 1.18E-06                   | 3.95E-04        |                          |                        |
| <i>Fluorene</i>               | 8.86E-06                   | 2.97E-03        |                          |                        |
| Formaldehyde                  | 2.05E-02                   | 6.86E+00        | 3.30E+01                 | NO                     |
| <i>Ideno(1,2,3-cd) pyrene</i> | 2.03E-07                   | 6.80E-05        | 4.40E-02                 | NO                     |
| Methanol                      | 3.06E-03                   | 1.02E+00        | 1.20E+05                 | NO                     |
| Methylene Chloride            | 4.12E-05                   | 1.38E-02        | 1.90E+02                 | NO                     |
| Naphthalene                   | 9.71E-05                   | 3.25E-02        | 2.70E+02                 | NO                     |
| <i>PAHs (3)</i>               | 1.49E-06                   | 4.99E-04        | 4.40E-02                 | NO                     |
| <i>Phenanthrene</i>           | 8.68E-06                   | 2.91E-03        |                          |                        |
| <i>Propylene</i>              | 4.12E-02                   | 1.38E+01        |                          |                        |
| <i>Pyrene</i>                 | 2.59E-06                   | 8.67E-04        |                          |                        |
| Styrene                       | 1.19E-05                   | 3.98E-03        | 1.40E+05                 | NO                     |
| <i>Toluene</i>                | 2.57E-03                   | 8.60E-01        | 3.90E+04                 | NO                     |
| Vinyl Chloride                | 7.18E-06                   | 2.40E-03        | 2.50E+00                 | NO                     |
| <i>Xylene</i>                 | 4.45E-04                   | 1.49E-01        | 5.80E+04                 | NO                     |
|                               | No Data                    |                 |                          |                        |

Notes:

1. AP-42, Chapter 3.2, Table 3.2-3 (4-Stroke, Rich Burn Engine), July 2000.
2. BAAQMD Regulation 2-1, Table 2-1-316.
3. PAHs emission factor includes only those compounds included in the 25 listed compounds per Brian Bateman's April 25, 2002 e-mail regarding PAH emissions. Data includes: Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, and Indeno(1,2,3-cd)pyrene as listed in CATEF.
4. Compounds that are italicized - Max. Emission Factors prescribed in CATEF II were used. In addition, a HHV of 1020 Btu/scf was assumed.
5. Heat Input Rate = 0.797 MM Btu/hr
6. Engine assumed to operate for 7000 hrs/year, per permit application

A Toxic Risk Screen Analysis is not required for Source 1 since none of the Toxic Air Contaminant emissions exceed the BAAQMD's trigger levels as presented in Regulation 2, Rule 1, Table 316.

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**Application Number: 6123**

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**CUMULATIVE INCREASE**

This is a new plant with no existing sources so there are no current cumulative increase emissions.

**NO<sub>x</sub>:** 0.0 tons/yr (current) + 0.0678 tons/yr (proposed) = 0.0678 tons/yr (new total)  
**CO:** 0.0 tons/yr (current) + 0.3736 tons/yr (proposed) = 0.3736 tons/yr (new total)  
**SO<sub>x</sub>:** 0.0 tons/yr (current) + 0.0016 tons/yr (proposed) = 0.0016 tons/yr (new total)  
**PM<sub>10</sub>:** 0.0 tons/yr (current) + 0.0265 tons/yr (proposed) = 0.0265 tons/yr (new total)  
**POC:** 0.0 tons/yr (current) + 0.0050 tons/yr (proposed) = 0.0050 tons/yr (new total)

**BACT**

S-1 does not trigger Best Available Control Technology since controlled emissions from all pollutants are below the trigger level of 10 lbs/day as outlined in Section 2-2-301. Although not required by BACT, this natural gas engine is abated by NSCR, which would likely satisfy the District's requirement. Therefore, no condition limiting the source to 10 lbs per day is needed.

**OFFSETS**

Offsets are not required since plant 14830 is new (i.e. has no emissions reported emissions data) and this application does not emit more than 15 tons of precursor organic compounds and/or nitrogen oxides or more than 1 ton of PM<sub>10</sub> and/or sulfur dioxide that trigger offsets per Rule 2-2.

**STATEMENT OF COMPLIANCE**

S-1 is a new engine rated at 85 bHP and therefore is not subject to Regulations 9-8-301, 9-8-302, and 9-8-502 pursuant to Regulation 9-8-110.1 (Engines rated by the manufacturer at less than 250 brake horsepower output rating). S-1 is subject to the SO<sub>2</sub> limitations of Regulation 9-1-302 (ground level concentration) and 9-1-304 (0.5% by weight in fuel). Because S-1 is a natural gas fired engine, it is expected to comply with these requirements.

Per Regulation 6, Section 303 (emissions opacity limitations), a person shall not emit for a period or periods aggregating more than three minutes in any hour, a visible emission that is as dark or darker than No. 2 on the Ringelmann Chart, or of such opacity as to obscure an observer's view to an equivalent or greater degree, nor shall said emission, as perceived by an opacity sensing device in good working order, where such device is required by District regulations, be equal to or greater than 40% opacity. A new natural gas fired engine is expected to comply with this requirement.

This application is considered to be ministerial under the District's proposed CEQA guidelines (Regulation 2-1-311) and therefore is not subject to CEQA review. The engineering review for this project requires only the application of standard permit conditions and standard emission factors in accordance with Permit Handbook Chapter 2.3.

This project is within 1,000 ft of the nearest public school and is therefore is subject to the public notification requirements of Regulation 2-1-412.

A toxic risk screening analysis was not required.

BACT, PSD, NSPS, and NESHAPS are not triggered.

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**Application Number: 6123**

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**PERMIT CONDITIONS**

APPLICATION 6123; CITY OF BRENTWOOD; PLANT 14830; CONDITIONS FOR S-1:  
**(PC 20059)**

1. The owner/operator shall exclusively fire Natural Gas in S-1. The owner/operator shall ensure that the total fuel consumed by S-1, does not exceed 5.47 million SCF<sup>1</sup> of Natural Gas during any consecutive 12-month period.  
(Basis: Cumulative Increase)

2. The owner/operator shall abate emissions from S-1 at all times of operation by a Non-Selective Catalyst Reduction (NSCR) Catalytic Converter that meets the following emission rates when tested at full load:

|                    |           |          |
|--------------------|-----------|----------|
| NO <sub>x</sub> :  | 0.0243    | lb/MMBtu |
| CO:                | 0.1339    | lb/MMBtu |
| SO <sub>2</sub> :  | 5.87 E-04 | lb/MMBtu |
| PM <sub>10</sub> : | 9.5 E-03  | lb/MMBtu |
| VOC:               | 1.78 E-03 | lb/MMBtu |

(Basis: Cumulative Increase)

3. The owner/operator shall not be required to comply with emission rates outlined in item 2 of this permit condition for the first 10 minutes after starting up S-1.  
(Basis: Cumulative Increase)

4. The owner/operator shall demonstrate compliance with condition 3, within 60 days of installing and starting up source 1, and annually thereafter, by conducting source tests on source 1 to verify the POC, NO<sub>x</sub> and CO emission rates using the following test procedures:

- Hydrocarbons (POC) - ARB Test Method 100 or EPA Test Method 25A
- Nitrogen Oxides (NO<sub>x</sub>) - ARB Test Method 100 or EPA Test Method 7E
- Carbon Monoxide (CO) - ARB Test Method 100 or EPA Test Method 10
- Oxygen - ARB Test Method 100 or EPA Test Method 3A
- Gas Flow Rate - ARB Test Method 1 through 4 or EPA Test Method 1 and 2

(Basis: TBACT/BACT Workbook)

5. Prior to the start up of source 1 and before any source test can be conducted on source 1, the owner/operator shall submit a source test protocol to the District for approval before any source test is performed. The owner/operator shall ensure that the protocol includes among other things the relevant test methods and sample port locations.

(Basis: Cumulative Increase)

6. To determine compliance with the above conditions, the owner/operator shall equip S-1 with non-resettable totalizing meters that measure the fuel usage. The owner/operator shall maintain all records of engine operation and fuel usage for at least 24 months, and shall make the records available for inspection by BAAQMD staff upon request. These record-keeping requirements shall not replace the record-keeping requirements contained in any applicable District regulations. The monthly log of operations shall include the following:

- a. Catalyst Purchase Records
- b. Fuel Consumption in million SCF and/or therms

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<sup>1</sup> 5.47 million scf = (797,000 Btu/hr) \* (7000 hrs/yr) \* (1 scf/1020 Btu). A HHV of 1020 Btu/scf is assumed.

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c. All Source Test Records  
(Basis: Cumulative Increase)

**RECOMMENDATION**

Issue the CITY OF BRENTWOOD a conditional Authority to Construct for the following equipment:

S-1      Gas Fired Prepackaged Cogeneration Unit, 60 kW: Rich Burn Natural Gas Spark Ignition Engine,  
Make: Tecogen, Model: CM-60, Rated Horsepower: 85 HP. Abated by Non-Selective Catalyst  
Reduction (NSCR) Catalytic Converter: Make: Johnson Matthey.

|            |  |             |
|------------|--|-------------|
| <b>BY:</b> | <b>Barry G. Young</b><br>Principal Air Quality Engineer              | <b>Date</b> |
|            | <b>Nicholas C. Maiden</b><br>Temporary Air Quality Permit Technician | <b>Date</b> |